SYSTEMATIC IMPLICATIONS OF THE DISTRIBUTION OF IRIDOIDS AND OTHER CHEMICAL COMPOUNDS IN THE LOGANIACEAE AND OTHER FAMILIES OF THE ASTERIDAE[1]

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Abstract

The distribution of the chemical compounds iridoids, anthraquinones, and verbascosides is demonstrated in Dahlgrenograms. An analysis of iridoid biosynthesis and structure allows distinction of two main groups of compounds. Thus, the biosynthetic *route I* gives rise to the seco-iridoids and their derivatives, and another (*route II*) to aucubin and similar decarboyxlated iridoid glucosides. Seco-iridoids from *route I* are widely distributed in Cornanae, Loasanae, and Gentiananae but never in Lamianae. Aucubinlike compounds derived by *route II* are commonly found in Lamianae and in three small families in Cornanae, but are not found in Gentiananae. Ericanae contain both groups, but not within the same order. Likewise, two biosynthetically different groups of anthraquinones can be distinguished, one of which is found solely in Gentiananae and in Lamianae, and thus suggests the monophyletic origin of these taxa. The distribution of the verbascosides, a group of caffeic acid esters, and cornoside, a compound that is often vicarious for iridoids, is shown to be limited to Lamianae and Oleaceae (Gentiananae), barring a few exceptions. This, together with other evidence, may suggest that Oleaceae systematically belong close to Scrophulariaceae, despite the presence of seco-iridoids in Oleaceae. The results of an investigation of the family Loganiaceae, as delineated recently by Leeuwenberg, are presented and analyzed in light of the above distributional patterns. The chemical data, combined with a few morphological characters, reveal that the tribes Spigelieae, Loganieae, Strychneae, Gelsemieae, and Antonieae show many similarities and are characterized by containing seco-iridoids (biosynthetic *route I*), by having intraxylary phloem and nuclear endosperm formation, and by lacking verbascosides. The tribe Potalieae share this set of characters, but because of the presence of a unique combination of compounds, elsewhere only found in Gentianaceae, it may fit better in that family. The tribes Plocospermeae, Buddlejeae, and Retzieae, as well as the genus *Polypremum* from Spigelieae, do not belong in the Gentianaceae, because they are all different in the above set of characters. Chemically (and morphologically), they are more closely related to Scrophulariaceae and its allies or, alternatively, Oleaceae. Our studies have revealed nothing conclusive about tribe Desfontainieae.

Chemical characters have been used extensively in only one of the comprehensive angiosperm systems (R. Dahlgren, 1974, 1975a, 1980; G. Dahlgren, 1989). In this classification scheme, data on the distribution of secondary chemical compounds are incorporated in a rational way. Additionally, Dahlgren continued to construct detailed graphical representations of his system, a feature making it more comprehensible for nonspecialists as well as providing a demonstration of the distribution of characters. Such representations have been coined Dahlgrenograms by Mølgård (1985).

Hegnauer, in his *Chemotaxonomie der Pflanzen* (1962–1990), was among the first to realize the full potential of secondary compounds in systematic botany, but he also saw that the main difficulty was the lack of sufficient information. Only a small proportion of the known plants have been investigated chemically, and large gaps in the knowledge of the distribution of secondary compounds are still evident, making the use of them difficult. However, some types of compounds have been fairly comprehensively investigated; the distributions of some are presented in Dahlgrenograms (Dahlgren et al., 1981).

Another difficulty is deciding whether a chemical

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